PATENT SPECIFICATION

Inventor: ERHARD MARTIN

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COMPLETE SPECIFICATION

Apparatus for Tensioning Filamentary Material

We, DUNLOP RUBBER COMPANY LIMITED, a British Company of 1, Albany Street, London, N.W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus for controlling the tension in a filamentary material as it is being fed to a winding device and particularly to apparatus for controlling the tension in very delicate or fragile material, e.g. glass fibre yarn, as it is being fed to a winding machine in the manufacture of glass fibre air bottles.

Resin-coated glass fibre air bottles are formed by winding a resin coated glass fibre yarn around a former in such a manner that an envelope of substantially uniform thickness is built up, which, on curing, provides a high pressure air container of great strength and durability. The former rotates and draws a number of ends of yarn each from a bobbin and through a bath of resin. It is necessary that the tension in each end of yarn is individually controlled to obtain the best possible result. However, owing to the delicate nature of the glass fibre it has been found that the devices which utilize dynamic friction are unsuitable since they are liable to break or damage the fibres and the object of the present invention is to provide an improved tensioning apparatus which is particularly suitable for glass fibre and like delicate filamentary material.

According to the present invention apparatus for controlling the tension in filamentary material comprises a rotatable drum having a peripheral band of resilient material, means for applying a retarding torque to said drum, means for guiding said filamentary material around a substantial part of said peripheral band, and means to prevent any adjacent portions of said filamentary material from touching each other.

The dimensions of the drum are so chosen as to prevent relative movement between the filamentary material and the band and thereby eliminate dynamic friction between the material and the band. For this reason also, if the material completely encircles the drum, said guiding means should be so arranged as to prevent chafing of the material at the cross-over point. The resilient band is preferably rubber, the hardness thereof being determined with regard to each particular application.

The load on the filamentary material from the winding end causes said material to bite into the rubber band encircling the drum so that, on an increase in the braking force applied to the drum, the tension is increased proportionally between the drum and the winding end, providing the wrapping angle of the material around the drum is sufficient to prevent slip. As the filamentary material encircling the drum bites into the rubber, so does it find an increased supporting surface in the rubber and thus the load/unit length of material need not rise to such a value that failure of the materials results.

The retarding torque on the drum may be applied mechanically by a braking pad or by other like means. Preferably means are provided for varying the torque.

The invention will now be described with reference to the accompanying drawings of which:—

Figure 1 is a diagrammatic representation of an apparatus for tensioning filamentary material constructed according to the invention.

Figure 2 is a part-sectional side view of the apparatus of Figure 1.

Figure 3 is a diagrammatic representation of the effect achieved by the apparatus of Figures 1 and 2.

Figure 4 is a sectional view of part of the apparatus of Figure 1 showing the relative positions of the filamentary material when subjected to relatively high tensile stress.

Figure 5 is a perspective view of apparatus constructed according to the invention for tensioning a plurality of strands of filamentary material.

One embodiment of the apparatus (Figure 1) comprises a narrow drum 1 rotatable on an axle 2. Said drum 1 is peripherally grooved and a rubber band 3 is located in said groove. Retarding torque is applied to the peripheral flanges 4 of the drum 1 by a brake pad 5 and the braking effect is regulated by a screw 6. An end of glass fibre yarn 7 is led from a bobbin 8, through a grid (not shown) and thence substantially once around the rubber band 3 in the peripheral groove of the drum 1. Small rollers 9 and 10 are provided to ensure that the fibre 7 does not chafe on itself at the cross-over point 11 as it makes contact with and leaves the drum 1.

With the screw 6 set to a certain value a retarding force is applied to the drum 1. The friction between the glass fibre yarn 7 and the rubber covered peripheral surface of the drum, about which the yarn is wrapped, causes a gradual increase in tension in the yarn from a point at which the yarn makes contact with the drum and the point at which it leaves the drum and this effect is illustrated diagrammatically in Figure 3, where the length of the radially extending lines 12 are directly proportioned to the value of the tensile stress existing in the yarn at that position on the periphery of the drum. Thus, to arrive at any given winding tension, and providing the wrap angle α of the yarn about the drum is sufficient to prevent slip, the braking torque is adjusted by means of the screw 6. For convenience the yarn is wrapped around the drum, substantially as illustrated to give a wrap angle of the order of 315°.

An advantage of the present invention is that if, for some reason, a high winding tension is required and the braking torque is adjusted accordingly, so the yarn bites deeper into the rubber and obtains an increased supporting surface.

This is illustrated at Figure 4 from which it is seen that the arc of contact β increases when the fibre yarn 7 bites deeper into the rubber band 3 due to the tension existing in the fibre yarn 7. Thus although the load at the winding end may be increased this does not necessarily increase the load/unit length of yarn encircling the drum. The degree of hardness of the rubber band must be chosen with care for each particular application and, as an example, for a 12" diameter drum a rubber band of 40 Shore hardness is provided for a glass fibre yarn 150/1, i.e. a single end yarn weighing one pound for every 15,000 yards, the tension then being variable between 50 and 1,000 grammes.

The diameter of the drum 1 is so arranged that no slippage or relative movement takes place between the yarn 7 and the drum 1 so that for practical purposes, the only dynamic friction in the apparatus is between the brake pad 5 and the peripheral flanges 4 of the drum 1.

In a further embodiment of the invention (Figure 5) which is particularly suitable for incorporation with apparatus for winding glass fibre bottles a shaft 13 is adapted to support a plurality of drums 1 each having a brake pad 5 and a screw 6 as described in the previous embodiment. Separate strands of fibre yarn 14 are passed through a grid 15 and guide rollers 16 to each of the drums 1, engaging the rubber covered peripheral surface thereof and tensioned in the manner previously described, additional rollers 17 being provided to prevent the strands chafing at their respective cross-over points.

Filamentary and like materials other than glass fibre yarn may be used.

What we claim is:—

1. Apparatus for controlling the tension in filamentary material comprising a rotatable drum having a peripheral band of resilient material, means for applying a retarding torque to said drum, means for guiding said filamentary material around a substantial part of said peripheral band, and means to prevent any adjacent portions of said filamentary material from touching each other.

2. Apparatus according to claim 1 wherein means are provided to vary said retarding torque.

3. Apparatus according to either of the preceding claims wherein the friction between said filamentary material and the said peripheral band is sufficient to rotate the drum against the retarding torque without relative sliding between said filamentary material and said peripheral band.

4. Apparatus according to claim 3 wherein said resilient band is adapted to be distorted by said filamentary material to increase the area of contact therewith when said filamentary material is tensioned.

5. Apparatus for controlling the tension in a plurality of strands of filamentary material comprising a plurality of drums, each constructed in accordance with any one of the preceding claims 1 to 4, which are rotatably mounted on a common shaft.

6. Apparatus for controlling the tension in filamentary material constructed and arranged substantially as described herein and illustrated in Figures 1, 2 and 4 of the accompanying drawings.

G. W. I. SHEAVYN,
Agent for the Applicants.

PROVISIONAL SPECIFICATION

Apparatus for Tensioning Filamentary Material

We, DUNLOP RUBBER COMPANY LIMITED, a British Company of 1, Albany Street, London, N.W.1, do hereby declare this invention to be described in the following statement:—

This invention relates to apparatus for controlling the tension in a filamentary material as it is being fed to a winding device and particularly to apparatus for controlling the tension in very delicate or fragile material, e.g. glass fibre yarn, as it is being fed to a winding machine in the manufacture of glass fibre air bottles.

Resin-impregnated glass fibre air bottles are formed by winding a resin-impregnated glass fibre yarn around a former in such a manner that an envelope of substantially uniform thickness is built up which, on curing, provides a high pressure air container of great strength and durability. The former rotates and draws a number of ends of yarn each from a bobbin and through a bath of resin. It is necessary that the tension in each end of yarn is individually controlled to obtain the best possible result. However, owing to the delicate nature of the glass fibre it has been found that the devices which utilize dynamic friction are unsuitable since they are liable to break or damage the fibres and the object of the present invention is to provide an improved tensioning apparatus which is particularly suitable for glass fibre and like delicate filamentary material.

According to the present invention apparatus for controlling the tension in filamentary material comprises a rotatable drum having a peripheral band of resilient material, means for applying a retarding torque to said drum and means for guiding said filamentary material around a part at least of said peripheral band.

The dimensions of the drum are so chosen as to prevent relative movement between the filamentary material and the drum and thereby eliminate dynamic friction between the material and the drum. For this reason also, if the material completely encircles the drum, said guiding means should be so arranged as to prevent chafing of the material at the cross-over point. The resilient band is preferably rubber, the hardness thereof being determined with regard to each particular application.

The load on the filamentary material from the winding end causes said material to bite into the resilient band encircling the drum so that, on an increase in the braking force applied to the drum, the tension is increased proportionately between the drum and the winding end, providing the wrapping angle of the material around the drum is sufficient to prevent slip. As the filamentary material encircling the drum bites into the rubber, so does it find an increased supporting surface in the rubber and thus the load/unit length of material need not rise to such a value that failure of the material results.

The retarding torque on the drum may be applied mechanically by a spring-loaded cord passing part of the way around the drum or by a braking pad or by like means. Preferably means are provided for varying the torque.

One embodiment of the apparatus comprises a narrow drum rotatable on an axle. Said drum is peripherally grooved and a rubber band is located in said groove. A cord is passed part-way around the periphery of said drum adjacent the rubber band, one end of said cord being secured to a framework and the other end secured to a spring which is adjustably secured to said framework. Said spring is tensioned to impose a predetermined torque on the drum. Alternatively, retarding torque may be applied to the peripheral flanges of the drum by a brake pad and in this case the braking effect is regulated by a screw. An end of glass fibre yarn is led from a bobbin, through a grid and thence substantially once around the rubber band in the peripheral groove of the drum. Small rollers are provided to ensure that the fibre does not chafe on itself at the cross-over point as it makes contact with and leaves the drum.

With the spring tensioned or the screw set to a certain value a known retarding force is applied to the drum. The friction between the glass fibre yarn and the rubber peripheral surface of the drum, about which the yarn is wrapped, causes a gradual increase in tension from a point at which the yarn makes contact with the drum and the point at which it leaves the drum. Thus, to arrive at any given winding tension, and providing the wrap angle of the yarn about the drum is sufficient to prevent slip, the braking torque is adjusted by means of the screw, or by varying the rating of the spring. For convenience the yarn is wrapped around the drum to give a wrap angle of the order of 315°.

An advantage of the present invention is that if, for some reason, a high winding tension is required and the braking torque is adjusted accordingly, so the yarn bites deeper into the rubber and obtains an increased supporting surface. Thus although the load at the winding end may be increased this does not necessarily increase the load/unit length of yarn encircling the drum. The degree of hardness of the rubber band must be chosen with care for each particular application, and as an example, on a 12" diameter drum a rubber band of 40 Shore hardness may be provided for a glass fibre yarn 150/1, i.e. a single end yarn weighing one pound for every

15,000 yards, the tension then being variable between 50 and 1,000 grammes.

The diameter of the drum is so arranged that no slippage or relative movement takes place between the yarn and the drum so that, for practical purposes, the only dynamic friction in the apparatus is between the brake pad and the peripheral flanges of the drum.

The apparatus herein described may be incorporated into apparatus for winding glass fibre bottles and in this case as many as twelve glass fibre ends of yarn may be fed through a grid and each through a rubber-banded drum independently braked and rotating on a common axle. Each drum is provided with its own small rollers for guiding the fibre to prevent chafe.

Filamentary and like material other than glass fibre yarn may be used.

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Fig.1.

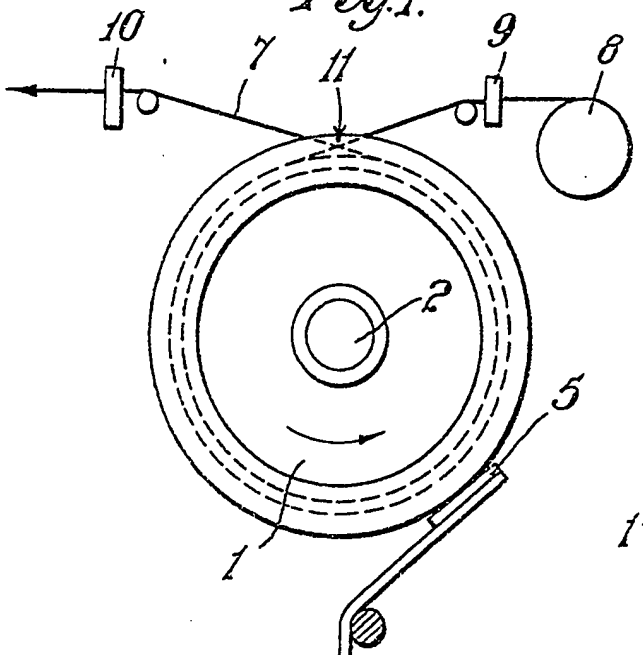
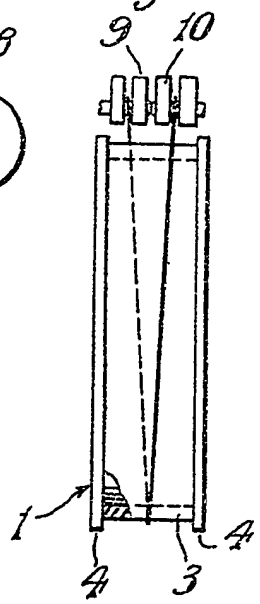


Fig.2.



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17

13

Fig.3.

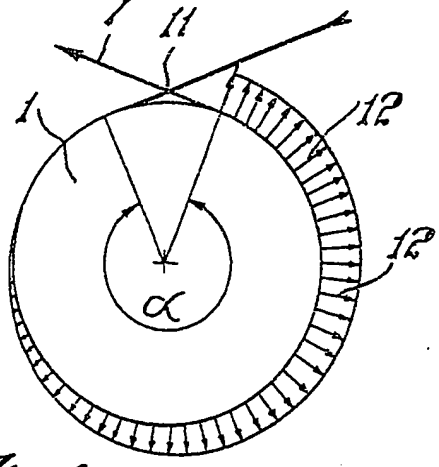
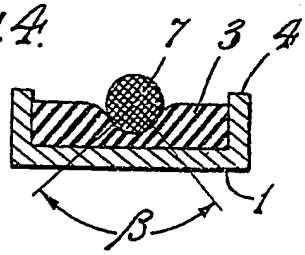


Fig.4.



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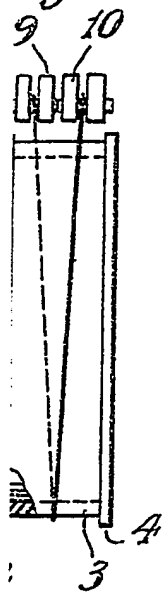
2 SHEETS

Fig.2.



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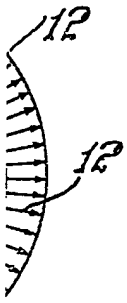

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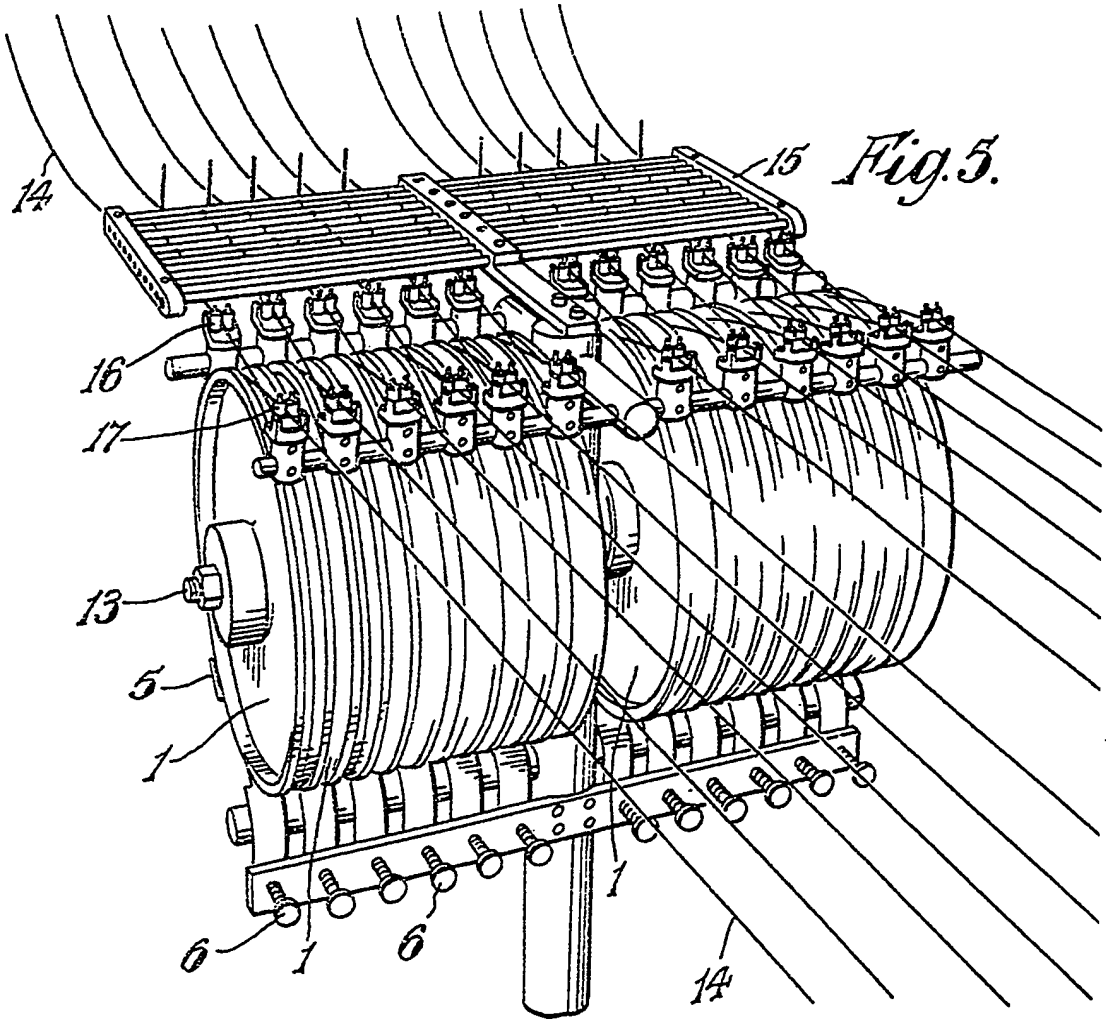
Fig.5.



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2 SHEETS
This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 2